Australasian Plant Conservation

Bulletin of the Australian Network for Plant Conservation Inc

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Special theme: Cryptogams

Introducing the new ANPC president | Myxomycetes fungi and conservation | Biocrusts form and function | Considerations for large-scale biodiversity reforestation plantings | Seed bank collaboration across the Nullarbor and much more...

ANPC INC. MISSION STATEMENT: To promote and improve plant conservation

ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia

T (02) 6250 9509 | **F** (02) 6250 9528
E anpc@anpc.asn.au
W www.anpc.asn.au

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New Zealand Plant Conservation Network

President Sarah Beadel
Secretary Rewi Elliot

PO Box 2199, Wellington, New Zealand

E info@nzpcn.org.nz
W www.nzpcn.org.nz

Errata

We apologise for a number of errors that slipped through the process in issue 24 (2):

Page 1 (contents page) and page 5 – The correct spelling of the surname for the author of the paper is Macnamara.

Page 20 – The mention in the right hand column to London Plant Tree should be to London Plane Tree.

Front cover: *Trichia verrucosa*. 3mm high. Photo: Sarah Lloyd

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Australasian Plant Conservation

Editor
Paul Adam

Editorial Team
Kate Brown, Anne Cochrane, Paul Gibson-Roy, Michelle Haby and Jo Lynch

Layout & Graphic Design
Siobhan Duffy

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Contributing to *Australasian Plant Conservation*

Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. General articles on any plant conservation issue are most welcome.

The deadline for the March – May 2016 issue is 12 February 2016. The special theme for the issue is *Commemoration of the work of Roger Good – alpine and upland habitats*. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Paul Adam: editor@anpc.asn.au

Authors are encouraged to submit images with articles or information. Please submit images in electronic format, resolution needs to be at least 300 dpi, at least the size that they are to be published, in tif, jpg or gif format. Guidelines for authors and an article template are at: http://www.anpc.asn.au/apc.

Using the article template, please send articles, no more than 1200 words, as an MS Word file by email to: editor@anpc.asn.au.

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This issue

Regular features

The production of this edition of *Australasian Plant Conservation* was supported by the **NSW Environmental Trust** through its Lead Environmental Community Groups program.

From the editor

PAUL ADAM

Welcome to the first issue of *Australasian Plant Conservation* for 2016, and the first edition to be printed in full colour! I hope you find it more attractive and enjoyable to read.

The New Year has opened with extreme events around the country, with fires in several states and torrential rain along the east coast. As Dorothea MacKellar correctly summarised, Australia is a land of 'droughts and flooding rains' – when organising fieldwork or planning restoration projects we must always plan for the contingency of extreme events, but we must be mindful that what is a disaster from a human perspective may be tolerated by some plants or even be essential for completion of life cycles.

We start the issue with the President's address to the 2015 ANPC Annual General Meeting and thank David Coates for his hard work during his term, which has left ANPC in good health. We also warmly welcome our new President, Linda Broadhurst, and look forward to her tenure.

The theme of this issue is Cryptogams. This is a term from Victorian (era, not State) botanical textbooks, with a distinction drawn between spore producing plants (the cryptogams) and seed plants. The cryptogams included ferns and bryophytes, but also fungi and lichens, and, in aquatic environments, algae. Fungi today are recognised as belonging to a different kingdom from plants, but are still generally regarded as honorary plants (and certainly they are not animals) and were included in the botany curriculum. This was still the case when I was a student, although there was also a tradition of at least some aspects of mycology (the study of fungi) being taught as microbiology, even though many fungi are multicellular and certainly not micro.

Today there is increased general interest in macrofungi, as evidenced by the number of field guides to the fungi of particular areas which are now available, but the number of professional mycologists in Australia is small and opportunities for detailed study of fungi in Tertiary courses are limited. This is an issue not just in Australia but internationally. The declining expertise base is concerning at a time when we are becoming aware of the impact of pathogenic fungi – ANPC has played an important role in raising awareness of the impact of Myrtle rust, through the workshops developed and delivered by our Vice President Bob Makinson.

Modern molecular tools are overturning former certainties about the number and nature of the biological kingdoms. The category cryptogam is now recognised as an artificial, but still useful, grouping which includes

Paul Adam

a number of kingdoms. In the case of the slime moulds, the myxcomycetes, there are several opinions as to which kingdom they belong (but they are certainly not part of the fungal kingdom), but this does not prevent their recognition as a distinctive and fascinating group of organisms which are discussed and illustrated by Sarah Lloyd.

In this issue, we can only cover a few of the groups within the cryptogams, but hopefully this is sufficient to excite interest and encourage investigation of other groups.

Many of the cryptogams are, when we view them at an appropriate scale, spectacular as is shown in the remarkable images which illustrate the articles.

The groups of organisms discussed in the articles are important components of biodiversity, but their exact role in ecosystem processes is not widely appreciated, and the identity and distribution of individual species is poorly documented.

Conservation of most cryptogams occurs largely by default, because of their occurrence in ecosystems and habitats conserved for other values.

However, interest in conserving cryptogams in their own right is developing. Amongst the basidiomycetes there has been particular attention given to waxcaps (the family Hygrophoraceae). In the European Union priority is given to conserving sites with rich assemblages of waxcaps, and mitigation measures are required when development impacts such sites. Barry Wright discusses one such example. In New South Wales the Hygrocobeae community of Lane Cove Bushland Park in the Sydney

Basin Bioregion is a *Critically Endangered Ecological Community* under the *Threatened Species Conservation Act*. Ray and Emma Kearney discuss recent observations on this community, and the outcome of site management initiatives. Although waxcaps are prominent in the community, it differs from European examples where waxcaps are found in grasslands. Management prescriptions from Europe are unlikely to be directly applicable in Australia – but the lesson I would draw from the English example is that seeking to conserve fungi is a global concern and that we need much more research to develop techniques to achieve conservation goals in different situations. There are probably more fungal communities which should be given formal conservation status in Australia, but if they are recognised as threatened then management measures must be developed and implemented to improve their conservation status.

Alison Pouliot displays some of the beauty in the diversity of macrofunal fruiting bodies in her photoessay.

Cryptogams are the basis of the biocrusts which occur in many situations across the Australian landscape. Max Mallen – Cooper discusses the ecological importance of biocrusts and shows that we do not need to identify all the species present, as the predominance of particular functional groups at a site allows evaluation of both ecological roles and threats. Wendy Williams and colleagues describe biocrusts in western Queensland. Restoring damaged biocrusts is likely to become an important task in repairing damaged landscapes, but, before we can do this, much more knowledge about the composition and ecology of biocrusts will be required.

The issue also includes the next two instalment of Dan Cole and Greg Siepen's series on reforestation plantings and the regular items – member profile, book reviews, a workshop report and the research roundup.

President's Report

To the Annual General meeting, 22 November 2015.

DAVID COATES

The 10th Australasian Plant Conservation Conference held in Hobart 11–14 November was an outstanding start to this year and highlighted the ANPC's capacity to bring together a broad range of professional and community groups to advance plant conservation in Australia. Risk taking and "thinking outside the box" were emphasised by a number of the speakers as key to achieving goals implicit in the conference theme '*Sustaining Plant Diversity – Adapting to a Changing World*'.

This is the 24th year of the ANPC and as I have confidently said over the last few years the ANPC continues to play a major role in facilitating and communicating plant conservation throughout Australia. There is ongoing community interest and support for plant conservation and this is reflected in the sustained level of membership in the ANPC, the continued participation of land managers, government departments, industry, the volunteer conservation movement and the broader community in ANPC workshops and conferences, and the requests we get from other organisations and government to participate in, and comment on various flora conservation initiatives.

Since its inception, the ANPC has been a key player in threatened plant conservation in Australia, and this year Jo Lynch and Mark Richardson had the opportunity to

David Coates

highlight some of our achievements and threatened plant conservation activities with the Threatened Species Commissioner, Gregory Andrews. At their meeting the Commissioner shared the ANPC's enthusiasm towards threatened plant conservation, and although acknowledging that threatened animals and birds tend

to have increased attention, he was keen to seek ways of heightening people's concern about threatened plants across Australia. A key outcome from this meeting, and following on from our submission of April 2014 on the Commissioner's draft terms of reference, was an invitation to the Threatened Species Summit in Melbourne in July this year. The ANPC was represented by Bob Makinson, with the summit a significant step forward for threatened species conservation in Australia. A number of documents were released on the day with the most significant a new Commonwealth Threatened Species Strategy (2015-2020) (http://www.environment.gov.au/biodiversity/threatened/publications/strategy-home) which includes targets for threatened plant conservation to 2020.

An important matter for the ANPC this year was the inquiry into the administration, transparency and effectiveness of the Register of Environmental Organisations under the *Income Tax Assessment Act 1997,* and was particularly relevant to the ANPC given the significance of tax exemption with our relatively small financial turnover and large voluntary contribution. We provided a submission to the inquiry drafted by Bob Makinson, and Bob and Jo Lynch represented the ANPC at a Public Hearing with the House of Representatives Standing Committee on the Environment regarding the Inquiry.

This year we also completed our first Prospectus, highlighting our capabilities, and the many ways both members and non-members can help further promote and improve plant conservation, such as through memberships, sponsorship, donations, bequests, project support, collaboration and volunteering. Special thanks go to the ANPC Management Committee members and Jo Lynch for all their work over the last couple of years in developing the Prospectus, and to Carly Westbye for the graphic design.

Importantly this year, the ANPC completed a Memorandum of Understanding with the Australian Seed Bank Partnership. This is aimed at strengthening ties between the two organisations and fostering continued collaboration in specific joint projects such as the Plant Germplasm Conservation in Australia publication, to facilitate joint research projects, to provide training and capacity building, and to create and exchange associated data and images.

We have continued to work with the Society for Ecological Restoration Australasia (SERA) on the development of the *Draft National Standards for the Practice of Ecological Restoration in Australia*. This document will outline the principles underpinning restoration philosophies and methods, and help identify appropriate ecological goals, objectives and measurable standards. It is anticipated that these Standards will be adopted by the community, industry, governments and land managers to raise the standards of practice across all sectors working in ecological restoration.

Conferences

The 10th Australasian Plant Conservation Conference held in November 2014 at the Royal Tasmanian Botanic Gardens (RTBG) Hobart, was a great success and celebrated the ANPC's return to Hobart 21 years after its inaugural Conference in 1993. The Conference included a fascinating array of guest speakers and great thematic sessions on securing biodiversity, partnerships for biodiversity, prioritising actions, animals in plant conservation and engagement and communication in the modern world. It also included an innovative technology practical session and some 'behind the scenes' tours of the Royal Tasmanian Botanic Gardens.

Climate change was a major overarching theme with a focus on how native plants are adapting to a rapidly changing climate, and what measures are being undertaken to help them adapt, including corridors and landscape restoration strategies. It also reported on other exciting developments in pollination ecology, co-extinction, seed germination (including the Australian Seed Bank Partnership), and genetics and conservation.

Professor Ian Lunt, Charles Sturt University, gave an excellent and thought provoking Keynote Address on the level of change in science, knowledge communication and response to change to set the theme of the conference. This theme was sustained throughout the conference and was reinforced in an exciting and entertaining lecture by Dr Bob Brown, in which he also expressed a degree of optimism about dealing with major environmental change faced in the immediate future. Overall the quality of the presentations was excellent with a number of the invited speakers highlighting the importance of developing and expanding our communication skills in promoting biodiversity issues with the broader public. We received very good feedback from the post conference survey results which can be found at https://www.surveymonkey.com/results/SM-PGB7TY27

I would again like to thank the conference organising committee: Lorraine Perrins, Jo Lynch, Mark Fountain, Nick Fountain-Jones, Jennie Whinam, James Wood, Natalie Tapson, Louise Gilfedder, Zoe Knapp and Arin Dean for their huge effort in coordinating the conference. In particular Lorraine Perrins, and Jo Lynch and Carly Westbye in the ANPC office, worked tirelessly to ensure that the conference ran smoothly and dealt with numerous details and issues that arose during Conference preparation.

This coming year the ANPC will be collaborating with the Australian Seedbank Partnership in holding the National Seed Science Forum to be held 14-16 March at the Australian Botanic Gardens, Mt Annan Sydney. The Forum offers a rare opportunity to bring together leading botanical and agricultural institutions, seed scientists, and conservation and restoration experts to

share ideas that showcase the importance of seed science to the future of plant conservation and food security in Australia.

Finally, the 11th Australasian Plant Conservation Conference will be held 15-18 November 2016 at the Royal Botanic Gardens Victoria. More information will be available very soon on the ANPC website http://www.anpc.asn.au/conferences/2016 and I look forward to catching up with many of you at this meeting.

Workshops, Projects and Outreach

This year ANPC Project Manager, Martin Driver, delivered seven very successful Provenance workshops throughout NSW. These were supported by the NSW Environmental Trust's Restoration and Rehabilitation grant program and NSW Local Land Services. The workshops were attended by a range of stakeholders in plant conservation and restoration, with a total of 304 participants. We would like to especially thank Linda Broadhurst and Mauritzio Rosetto for the time they contributed to these workshops. Martin also held an additional Provenance workshop exclusively for a large consultancy firm in Sydney, as well as a Rangelands Paddock Walk plant identification field day in the Hay district, with more similar days planned.

Two consultation workshops were held in Victoria for the Bring Back the Banksias project. Survey information is now being collated on the location and distribution of known relict or remnant populations of Silver Banksia (*Banksia marginata*) across its range in regional Victoria and south-western NSW, where it has undergone considerable decline. This information will be used to select sites/ populations for future genetic research that will help to guide seed collection strategies for the establishment of Seed Production Areas and future field restoration works.

Three successful Myrtle rust workshops were held in Darwin by Bob Makinson, and supported by the Bjarne K Dahl Trust, the Royal Botanic Gardens and Domain Trust, and various Northern Territory government organisations. A Myrtle rust information hub has recently been added to the ANPC Website covering much of the information Bob Makinson has collated and presented at a range of these workshops across Australia. Currently this is one of the major sources of information on Myrtle rust and a key reference site for this critically important plant pathogen.

Over the past 12 months, the ANPC has coordinated the sub-contracting of the Orchid Conservation Program to the Royal Botanic Gardens Victoria, and helped raise $41,387 through crowdfunding for the new orchid laboratory located at Cranbourne. This program implements a range of orchid conservation activities including translocation, pest and animal control, ex-situ conservation of orchid seed and associated mycorrhizal fungi, propagation, monitoring, and threat abatement.

More broadly our outreach efforts continue to expand through a range of social media with the regular sharing of news and events in plant conservation via Twitter, Facebook, Google+, and LinkedIn. The ANPC News email newsletter underwent a revamp and has been sent once a month since December 2014 to currently 656 subscribers. The new ANPC website was launched this year which is a major improvement. The new look website is more user-friendly and will soon accommodate online processing for membership applications and renewals, workshop and conference registrations, and publication sales. I'd like to thank Carly Westbye and Siobhan Duffy for all their work on this.

We are also in the process of adding another key information source to the ANPC website prepared by Bob Makinson - *Australian Plant Identification - a resource bibliography*. This is a compilation of all non-journal plant ID resources for wild species (native and naturalised), published in either print or electronic form since 1980, with annotation for each. In particular, it provides the first comprehensive coverage for non-journal resources. Bob has also been supplying extracts from this resource with a regional or plant-group focus for use as handouts at ANPC Plant ID workshops in recent years.

Our bulletin, *Australasian Plant Conservation (APC)*, has continued to publish high-quality articles relevant to a broad range of plant conservation practitioners and managers, under the editorship of Huw Morgan and Paul Adam. On behalf of the Committee and all members I would like to sincerely thank Huw and Paul for their significant effort in ensuring that APC continues to be a quality and well respected publication for the communication of plant conservation issues in Australia. A new and improved format for APC was also introduced this year and I'd like to thank Carly Westbye and Siobhan Duffy for all their work on this.

Funding

Our financial situation will be reported on in detail separately at the AGM but we continue to broaden our sources of income with this year producing a reasonable surplus, comparable to last year.

This year we had success with a significant number of grant and funding opportunities:

- NSW Environmental Trust's Lead Environmental Community Groups grant for website development and Riverina Plant ID workshops.
- Ten orchid conservation projects which were subcontracted to the new laboratory at Royal Botanic Gardens Victoria.
- Normal Wettenhall Foundation biodiversity conservation grant for the *Bring Back the Banksias Project* – 3 workshops and a survey.

- Workshop and field day components of Greening Australia project *Revegetating Threatened Riverina Sandhill Woodland Communities* funded by NSW Environmental Trust Restoration and Rehabilitation Grant Program.
- Collaboration with the Australian Seed Bank Partnership on the National Seed Science Forum for 14-16 March 2016 – scientific committee, planning and promotion.
- Communities for Nature Grant in Victoria for *Saving the Federally Listed Metallic Sun-Orchid and Wimmera Spider-Orchid from Weed Invasion*.
- Hunter & Central Coast Regional Environmental Management Strategy funded a Weeping Myall workshop.
- Workshop/field day component of OEH Albury Region Saving our Species (NSW) Orchid Project.
- Rangelands Paddock Walk – one day Plant ID field day funded by Riverina Local Land Services.
- Two field days funded by Trust for Nature (Victoria).
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I would especially like to thank Jo Lynch and Martin Driver for their great efforts in coordinating and preparing the numerous grant applications both successful and submitted this year.

Staffing

My thanks, as always, to our office staff Jo Lynch and Carly Westbye who continue to work well beyond the call of duty for the ANPC. Their dedication and the quality of their work make my job and the work of the Committee so much more effective, and ensures that the ANPC continues to function as a highly respected conservation organisation. I would also like thank Merryl Bradley for the many roles she still plays in supporting the ANPC. Merryl not only continues on in the position of Treasurer but also works as a volunteer in the office. Her experience and assistance is a great asset to the ANPC.

I am again grateful to Committee members for their tremendous support over the year. They all have significant commitments outside the ANPC and it is sometimes challenging to devote the time that they do in maintaining active participation as a committee member. The involvement in the Committee by all members is a clear demonstration of their dedication to the ANPC and its goals in improving plant conservation.

Four committee members, Paul Gibson Roy (Vice President), Zoe Knapp (Secretary), Mark Richardson and Bob Makinson, will be leaving their current positions. I sincerely thank them for their great support, enthusiasm and dedication over many years. As Secretary, Zoe Knapp had perhaps the toughest job of us all, organising committee meetings, recording the minutes and at the same time contributing to the many discussions. Mark Richardson, a founding member of the ANPC, provided the wisdom and strategic thinking that often enabled the Committee to move forward with sometimes difficult issues. They will both be sorely missed but I am confident they will continue to be actively involved with the ANPC into the future. Paul Gibson Roy has nominated as an Ordinary Member and I would like to thank him for his tremendous support as Vice President. Bob Makinson will be standing down as an Ordinary Member and nominating for Vice President. It is great to see Bob is willing to take on this role. He is a stalwart of this organisation and always prepared to take on more in moving the ANPC forwards.

The coming year

A number of workshops and projects are already in the planning stage by Martin Driver for next year. These include:

- Investigating the options for funding and delivery of a series of provenance issues workshops in regional Victoria.
- Two seed collection workshops in Broken Hill and Menendi for Western Local Land Services.
- Two Plant ID workshops in the Riverina LLS region.
- Investigating the opportunity for coastal rainforest species ID workshops.
- Pending funding approval: 4 x 2 day workshops in NSW on seed collection, storage and use; development of an on-line version of the Germplasm Guidelines; and updating the Florabank website, in collaboration with SERA and Greening Australia.

Of course, there is also our 11th Australasian Plant Conservation Conference to be held at the Royal Botanic Gardens Victoria next year.

This is my last term as President and it has been a pleasure and a privilege to work with all of you. I have thoroughly enjoyed being part of the executive and working in an organisation that does so much for plant conservation in Australia. I see an important future for the ANPC playing a key role in plant conservation across Australia and the region more broadly. I look forward to continuing my involvement as an Ordinary Member of the committee.

President, Australian Network for Plant Conservation Inc.
18 November 2015.

Introduction to new ANPC President

At the ANPC Annual General Meeting on 20 November 2015, Dr Linda Broadhurst was elected as the new ANPC President for a two year term. This will involve being the Chairperson of the ANPC Management Committee, managing the office staff on behalf of the Committee, helping set the direction of the organisation and overseeing the coordination of the ANPC Conference in Melbourne next year. Bob Makinson, as our new Vice President, will be assisting her in this role.

We would like to warmly welcome Linda aboard and recently caught up with her for a chat to find out more about her and her vision for the ANPC going forward.

Linda Broadhurst

First of all, welcome aboard Linda.

Thank you, I am excited to be taking over as President of the ANPC and at the prospect of further building awareness, interest and action in the conservation and restoration of our wonderful Australian native plants.

As a bit of a background for those who don't know you, where do you work and what projects are you working on at the moment?

I am the Director of the Australian National Herbarium in Canberra, one of CSIRO's six National Research Collections. At the moment my major research interests include assessing seed production areas to make sure they are producing high genetic quality seed for restoration. In conjunction with partners including the ANPC, we are also building a project to assess where and how to restore Silver Banksia (*Banksia marginata*).

How did you end up working in plant conservation? What/who inspired you?

I ended up working with plants by accident – I worked in banking and finance in Australia and overseas before returning to Australia to head back to university to study human biology. By chance I took a plant biology course as part of my undergrad program and the Tutor inspired a love of plants in me. I went on to do a PhD in the conservation of *Geleznowia verrucosa*, a monotypic species in WA. After that I worked for CALM (now DPaW) in WA before moving to CSIRO in 2000.

What are your goals/ where would you like to take the ANPC over the next two years?

I would like to see the ANPC become a stronger advocate for plant conservation in Australia, help educate the community about the important role that plants play and how we can help our unique and beautiful flora cope with a changing environment.

How do you see the role of the ANPC in linking science, management, and practitioners, especially those at the community level?

Linking science, management and practitioners is key to the ANPC through its long history of delivering important science concepts in a down to earth manner. The ANPC also plays a role in highlighting emerging science research areas that managers and practitioners have identified.

What do you see as the ANPC's strengths/ achievements?

A membership that is passionate about plant conservation. Some of the significant achievements have been the Germplasm and Translocation Guidelines as well as the Biennial Conferences and the many practitioner-orientated workshops that we hold very year.

And where do you think there is room for improvement?

We need to improve our visibility in the plant conservation world, build new relationships and strengthen existing ones.

Anything else you would like to mention?

As incoming ANPC President I wish to acknowledge the hard work of Dr David Coates and his team, and to thank them for their efforts over the past four years.

The enigmatic Myxomycetes

SARAH LLOYD

Birralee, Tasmania. Email: sarahlloyd@iprimus.com.au

Slime moulds are not usually thought of as cryptogams, but as they reproduce by spores they more or less fit the Oxford Dictionary of Plant Sciences definition 'plants that reproduce by spores or gametes rather than seeds, i.e. an alga, bryophyte or pteridophyte' (Allaby 1998). Except slime moulds are not plants.

Myxomycetes – what are they?

Acellular slime moulds, also known as myxomycetes or myxogastrids, are opportunistic ubiquitous organisms. They are most abundant in temperate forests but they also occur in tropical forests, alpine areas, heathlands, grasslands, deserts, and arctic and sub-Antarctic regions. In short, wherever there is organic material.

Myxomycetes were once included with plants when all living things were placed in just two kingdoms – plants and animals. When more kingdoms were created to encompass a vastly more complex world than was originally imagined, slime moulds were moved to the kingdom fungi. Indeed, they are often described as fungus-like organisms and, like most fungi, they make only a relatively brief appearance at their fruiting body stage. However, they do not have any structures analogous to fungal hyphae. So where to next?

Before long the pulsating feeding plasmodial stage of myxomycetes was discovered and they were moved to the animal kingdom. Then their single-celled amoeboid feeding stage was observed and they were moved again, this time to the kingdom protozoa. However, this kingdom does not encompass organisms that have an amoeboid, plasmodial and spore bearing stage. They are now considered to be Amoebozoans but whether Amoebozoa is a supergroup or a kingdom is matter of some debate. (Steven L. Stephenson personal communication.)

Life cycle

There are many variations on the following 'basic' life cycle:

Fruiting bodies produce spores from which emerge one to four amoebae called either myxamoebae or swarm cells.(They are myxamoebae if conditions are dry and flagellated swarm cells if conditions are wet.) These single-celled organisms, whose population can reach extraordinary numbers of between 10 and 1000 and sometimes 10 000 per gram of soil, move about in the soil or wood where they feed by engulfing bacteria – their principal food at this stage. The amoebae don't grow but divide into two identical cells. Sooner or later they find a compatible amoeba and fusion of their protoplasm and nuclei takes place, eventually forming a plasmodium. The plasmodium – the second feeding stage – moves about and feeds on bacteria, fungal hyphae, fruiting bodies and spores, algae (which can remain alive and green within the plasmodium), possibly lichens and probably each other. During this stage there is synchronous nuclear division resulting in the production of numerous nuclei: small plasmodia have several hundred nuclei; larger ones have millions. From the plasmodia (of which there are several kinds) arise one to several thousand spore-bearing fruiting bodies. There are a variety of fruiting bodies types, many of which are exquisitely beautiful.

Myxomycetes take 'hidden' to new depths. If they run out of food or things get too dry, they can revert to dormant structures at both their amoeboid and plasmodial stages. One can only wonder at the longevity of dormant amoeba and plasmodium – called microcysts and sclerotium respectively – hidden within woody substrates.

Moist chamber cultures

Researchers – usually mycologists – undertake surveys of myxomycetes by collecting any fruiting bodies that happen to be in the field, as well as copious amounts of substrate: bark, leaf litter, bryophytes etc. This is placed on wetted absorbent paper in Petri dishes and kept moist at room temperature. Fruiting bodies can appear within days but the material needs to be checked with a dissection microscope over the following weeks and months. This moist chamber culture technique is extremely important in the study of myxomycetes and can augment field collections by 20–60% of species, depending on the habitat.

Didymium clavus **(0.7 mm high) on treefern frond. Photo: Sarah Lloyd.**



(left to right) ***Alwisia lloydiae.*** **4.5mm tall.** ***Trichia verrucosa.*** **3mm high.** ***Arcyria*** **sp. 1.5mm tall. Photos: Sarah Lloyd**

Research in Northern Tasmania

Since 2010 I have studied myxomycetes in the wet eucalypt forest at Black Sugarloaf, Birralee in central north Tasmania (Lloyd 2014). I have over 1100 field collections representing approximately 120 species but have not used moist chambers because I have daily access to my study site.

The best time to find myxomycetes is several days after a bout of wet weather when active plasmodia and/or immature fruiting bodies are relatively easy to see – especially those that are white, yellow, bright red or hot pink when they first appear. They slowly darken over hours or days and all but disappear in the dim light of the forest. Mature fruiting bodies, most of which are around 2 mm tall, are usually only found when actively searching with a head lamp and hand lens.

The literature suggests that slime moulds are predominantly soil dwelling organisms that appear on logs and litter, so I started by searching the huge old bryophyte-covered eucalypt logs and sodden Dogwood (*Pomaderris apetala*). Before long I checked fallen trees and branches that remained off the ground because they were suspended in vegetation; standing dead trees; the fibrous stems of dead Clematis (*Clematis aristata*); the bark of living trees; and the litter that accumulates amongst the fronds of Treeferns (*Dicksonia antarctica*). All sites, at one time or another, have proven to be rich in slime moulds.

Identification – common, rare and 'new' species

Identification of the approximately 1000 species known worldwide is based entirely on the structure of their fruiting bodies which, unlike fungi, retain their shape and colour indefinitely if properly stored. (Myxomycetes are stored by gluing substrate with attached fruiting bodies to a piece of card that fits inside a small box – matchboxes are ideal.) Species are placed in one of five orders and once familiar with their appearance it is reasonably easy to assign to family or genus with the aid of a hand lens. However, assigning species names can be difficult. This is because the fruiting bodies are sensitive to changing conditions during the relatively short time they are forming and even those arising from the same plasmodium can vary greatly in shape, colour, development of the capillitium (thread-like structures within the spore mass), amount of deposited lime, spore size and decoration and 'practically every other factor which is used in the keys' (Martin and Alexopoulos 1969). Most specimens require microscopic examination with a compound microscope, and a page of colour photographs depicting all these features is needed to enable comparison with published descriptions.

Among the many species that have appeared at Black Sugarloaf are several new records for Australia including *Elaeomyxa reticulospora*, a species otherwise known only from the type locality in Java; and at least one new species, *Alwisia lloydiae* D.V. Leontyev, S.L. Stephenson & M. Schnittler(Leontyev *et al*. 2014). Whether this indicates a particularly rich site or simply that very few people are looking can only be determined if similar studies are undertaken elsewhere.

Conservation

The study of myxomycetes – let alone their conservation – is in its infancy in Australia (which is regarded as among the least studied countries in the world). However, retaining habitats with copious quantities of living and dead plant material of all ages should maintain a diversity of myxomycetes.

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Conservation of fungi in Lane Cove Bushland Park

RAY AND ELMA KEARNEY

Sydney Fungal Studies Group Inc. Email ray.kearney@sydney.edu.au

Fungi are neither plants nor animals and have a separate Kingdom. The number of species in the family Hygrophoraceae recorded in Lane Cove Bushland Park/ Osborne Park (LCBP/OP), Sydney is approximately 34 which ranks the site of international significance. All the knowledge on the nutritional aspects of species in the family Hygrophoraceae (now over 16 genera) comes from research in countries of the Northern Hemisphere (e.g. UK, Canada and USA) where the vast majority of species are different to those in Australia and LCBP/OP (Hallwach *et al*. 2013).

Waxcap fungi (family Hygrophoraceae) cannot be cultured on laboratory media and the correct conditions for inducing spores of most species to germinate have yet to be established.

Overseas research has concluded that unlike other fungi, the Hygrophoraceae are probably not saprophytes i.e. recyclers of organic material (Seitzman *et al*. 2011). Reports indicate that the failure to be cultured, coupled with the frequent association with bryophytes (e.g. mosses and liverworts), indicates an unusual nutritional strategy. The conclusion drawn from such research is that these species are biotrophic i.e. parasitic and derive their nutrients from a living host e.g. moss, cyanobacteria, algae and understory plants – either alone or in combination.

Some species in the genus *Hygrophorus* are known to be ectomycorrhizal (ECM) with roots of certain trees in a forest habitat. It is likely from our observations that many of the waxcaps found away from the creek, in LCBP/OP, are ECM fungi.

Researchers have found waxcap hyphae growing inside live fine roots of associated vegetation. Halbwachs *et al*. (2013) concluded that this group of fungi has a biotrophic lifestyle with plants. We have recorded certain species that are found commonly among moss on the creek bank.

In 2014, our field studies recorded fewer than eight of these 34 species throughout the main fruiting season (late May-early August) in LCBP/OP. We have been concerned about the overgrowth of Morinda Vine (*Morinda jasminoides*), which is a key threatening process as it smothers moss and encroaches on sensitive fungal sites. In collaboration with Lane Cove Council funds were obtained to commission commercial bush regenerators to clear this rampant spreader vine. In 2015, we voluntarily undertook to monitor and map the fruitbodies of all the waxcap species throughout LCBP/OP to assess any benefit of clearing Morinda Vine.

Our preliminary observations are summarised as follows:

Observation 1 – *The number of species recorded in LCBP/ OP during May-August exceeded those in any season of the previous five years.*

Some species e.g. *Hygrocybe lanecovensis* had not been observed in LCBP/OP since 2007, but were common this year. Of the 34 waxcap species, all but three were recorded by 8th July, 2015. Among the species, several variants (and/or hybrids) were common. Two new species, yet to be formally described, were collected.

Increased recordings of species were partly due to the removal of the Morinda Vine but importantly Sydney recorded the highest rainfall at Observatory Hill on 21st April (119.4mm) and 22nd April (105.8mm). Temperature and rainfall were confirmed as key cues for fruiting. The majority of the waxcap species produced fruiting bodies when the maximum daily temperature was below 18°C.

Observation 2 – *Over 20 new colonies of different waxcap species appeared in areas cleared of the Morinda Vine.*

New and previous colonies of different species of waxcaps appeared in sites cleared of Morinda Vine. It was also significant that the removal of the Morinda Vine allowed the regeneration of moss on the creek banks. Fruitbodies of some species e.g. *Hygrocybe erythrocala* appeared in the regenerated moss.

Observation 3 – *Most species were found mainly in leaf litter and not in moss.*

Our observations show that an obligate association with moss can be excluded for this critically endangered community of waxcaps because all species were found to colonise moss-free habitats.

Observation 4 – *Waxcap species which grow in moss also grow in leaf-litter.*

For example, *Humidicutis taekeri* was recorded growing in moss but was stunted in size when compared to the same species found growing in leaf-litter exposed by the clearing of Morinda Vine where this waxcap had not

been recorded previously. See photos below. Again, a dependency upon moss can be excluded. It should be noted that toxins in the polluted creek may influence the morphogenesis of fungi growing in moss along the banks of the creek.

Observation 5 – *Toxicity of the creek pollution was accompanied by abnormal fungal morphogenesis e.g. 'rosecomb'.*

Rosecomb is an epigenetic phenomenon recorded by commercial mushroom farmers when fungal mycelia are exposed to diesel fumes. The malformation is expressed by the gills emerging from the top of the pileus (cap). In LCBP, rosecomb occurs mainly in the moss banks over which water has washed leaving a zone of moss and a zone of leaf-litter. The source of such pollution is from road run-off and sewage overflows which are common.

Observation 6 – *Some waxcap species produce extraordinary large fruiting bodies in certain site-locations of dampness.*

Soil type is derived largely from Wianamatta shale and the older Hawkesbury sandstone. These waxcap species in LCBP/OP have a preference for regosol and dark coloured podosol soil types.

Observation 7 – *A co-existence (without moss) between* Humidicutis arcohastata *and* Hygrocybe aurantipes *led to an apparent hybridisation resulting in specimens with phenotypic characters of each species.*

Observation 8 – *Over 16 variants/hybrids of* H. rubronivea *and* H. lanecovensis *were recorded and collected.*

Observation 9 – *Several key threatening processes were confirmed, the newest being logjams which have led to the destruction of the habitat of at least two waxcap species.*

Observation 10 – *Some waxcap species e.g.* H. graminicolor, H. virginea, H. reesiae, H. collucera *and* H. griseoramosa *showed a high tolerance in regard to different soil types.*

Observation 11 – *Most of these waxcaps co-exist with ectomycorrhizal fungal species.*

These included *Cortinarius* sp., *Russula* sp., *Hebeloma* sp., *Inocybe* sp. and *Lactarius* sp. without evidence of avoidance. Along the creek banks, the Coachwood tree (*Ceratopetalum apetalum*), with which some waxcap species e.g. *Camarophyllopsis* sp., *Gliophorus irrigatus* and *G. chromolimoneus* seem closely associated, is dominant.

Humidicutis taekeri **(stunted) in moss (left) and leaf litter –** ***Morinda*** **removed (right). The circles in the habitat photographs indicate the locations of the specimens. Photo: Ray and Elma Kearney.**

Discussion

There are clear commonalities of habitats in which LCBP/OP waxcaps appear to prefer weakly developed soils of low fertility, but without mosses being obligate associates. Their peculiar nutritional behaviour requires further research on the trophic lifestyle to establish the host(s).

Consistent with overseas observations, waxcaps do not tolerate smothering. This was evident by the appearance of over 20 new colonies of various species in areas cleared of Morinda Vine (*Morinda jasminoides*) and other ground-cover. These measures along with addressing other threats should be part of the conservation management of these waxcaps. Current conservation decisions based solely on plants may not fulfil the requirements of the Hygrophoraceae species. Plants are not a good surrogate for Hygrophoraceae conservation (Seitzman *et al*. 2011, Vellinga 2014).

There was no evidence that these waxcaps avoided habitats where ectomycorrhizal fungi dominate consistent with observations of waxcaps in Canada and northern USA. In contrast, waxcaps in UK and Europe avoid habitats colonised by ectomycorrhizal fungi (Öster 2006).

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Waxcap conservation in England and Wales and a new approach to translocation

BARRY WRIGHT

Dryad Ecology, York, England Email: barry.wright@me.com

Waxcap fungi in the UK are increasingly recognised as a group of conservation priority species. Some rare species are referred to as Species of Principal Importance (formerly called UK Biodiversity Action Plan (BAP) species) under the Natural Environment and Rural Communities Act 2006 (NERC 2006). This requires our Secretary of State to publish a list of species that are of 'Principal Importance', e.g. the Date Waxcap *Hygrocybe spadicea*. For development in England, the National Planning Policy Framework (HMSO 2012) sets out guidance for local authorities to determine if a development should be permitted. This includes promoting the preservation, protection and recovery of priority species (Species of Principle Importance). Recently a number of statutory designated Sites of Special Scientific Interest (SSSIs) have been notified for their waxcap interest (Griffith 2013), re-inforcing the UK government commitment to waxcap conservation.

Waxcaps in the UK are mainly found in unimproved grassland, usually pastures, where the turf is grazed short by animals or in mown amenity grassland, church burial grounds, and golf courses. They are grouped, with other grassland fungi into CHEGD (Clavariaceae, *Hygrocybe*, *Entoloma*, Geoglossaceae, *Dermoloma*) species. A scoring system for evaluating CHEGD grassland is used in Griffith *et al*. 2013, to rank sites based on the number of species from each CHEGD taxon, individually and combined. Longshaw Estate in Derbyshire, England is ranked equal 3rd in the top twenty sites in the British Isles. It has a CHEGD score of C:11, H:30, E:26, G:7, D:0 and a total score of 74. This system is adopted by the Joint Nature Conservation Committee which has produced guidelines for the selection of biological SSSIs to record and protect sites of importance for grassland fungi (JNCC undated web document)

All CHEGD meadows are potentially important and are in decline due to ploughing and agricultural improvements (such as fertiliser application and drainage). Ing (1992) produced a provisional 'Red list' of threatened and endangered fungi, including CHEGD species. The heightened awareness that resulted induced more surveys to be done, removing some species from the provisional list when they were found to be more abundant. The Pink Waxcap *Hygrocybe calyptriformis* (Figure 1), for instance, was on the original list, but by 2006 it was recorded from more than 360 hectads (10km x 10km grid squares) and was removed from the list.

Figure 1. Pink Waxcap *Hygrocybe calyptriformis* at Valley Meadows translocation site on the Heysham to M6 Link road, north of Lancaster, UK. Photo: Barry Wright

Waxcap translocation case study

For a proposed road scheme north of the city of Lancaster to link the M6 motorway to Heysham, a suite of ecological surveys had been commissioned from ADAS (an ecological consultancy) between 2002 and 2003 that included a mycological survey. This revealed the presence of waxcaps on a series of grass fields known as Valley Meadows. These unimproved grasslands, under organic farming management, had a good assemblage of waxcap fungi (14 species) including the Pink Waxcap. In 2007 there was a public inquiry. Prior to the inquiry Pink Waxcap was on the Red list, but had been removed when the inquiry took place. At the inquiry the proposers of the road scheme, Lancashire County Council, expressed their intention to move waxcaps from parts of the field complex where they were present to locations in their mitigation area that currently showed no evidence of presence (vacant areas).

As the site was organically managed the owner was reluctant to allow the translocation of turves as this could have a significant adverse impact on the condition of his fields. After considering the alternatives, turf translocation was discounted, partly because there was no proven track record of its success. Attempts have been made to move turves containing fungal mycelia (Griffith *et al.* 2004) that have not shown evidence of success. The underground mycelia can take more than 20 years to produce fruiting bodies after disturbances (Griffith *et al*. 2004) making it difficult to judge success.

The method proposed was ultra-low impact involving the movement of fertile and spore-shedding mature fruiting bodies from donor areas to a receptor site (Figure 2). This was done during the fruiting period, September to December, 2014. A total of 1372 caps was collected of nine species, including two caps of Pink Waxcap. All 1372 caps were moved and placed gill side down in a defined receptor area that had no previous evidence of waxcaps, but had a similar grassland vegetation type to the donor sites (Figure 3). The basis of this approach was that the environment at cap level was effectively 'wind still' and limited the dispersal of spores. It was hoped that placing caps at the receptor site would more effectively move spores some distance from the core areas of the waxcaps and the spores would germinate and set up new colonies.

Figure 2. Air photograph showing the line of the road scheme and the donor and receptor sites within the mitigation area.

Figure 3. Mixed caps set on the ground at the receptor site. Photo: Barry Wright.

Recent developments mean that eDNA barcoding is now available to detect the presence of species at any time of year (not just during sporulation) and to detect the signature of species that may only fruit infrequently and where it may be difficult to confirm presence using normal fruiting body survey methods. This would have been useful to confirm that the 'vacant' receptor site was indeed vacant and the technique could be used in the future to confirm success in advance of any fruiting bodies becoming evident. The translocation may not show a positive outcome for many years if waiting for the first fruiting bodies. Barcoding may reveal success earlier. The ease of transferring caps and the low impact justified making an attempt rather than doing nothing.

Further detail on the translocation was originally prepared for the publications *In Practice* and also in *British Wildlife* in the UK (Wright 2015a, 2015b).

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Endless forms most bizarre

ALISON POULIOT

Australian National University, Canberra, ACT. Email: alison.pouliot@anu.edu.au

Without fungi, life is radically diminished. Fungi regulate the biosphere and support the earth's ecological functioning.

As the reproductive structures of fungi, sporophores alert us to the otherwise largely inconspicuous existence of underground mycelia.

The imperative to reproduce through spore production compels the evolution of diverse morphological forms, specialist strategies, and perfectly-tuned spore-dispersal mechanisms.

The result is an almost unimaginable bevy of endless forms most bizarre.

Here's just a few.

***Armillaria hinnulea* and *Mycena* sp.**

Biological soil crust morphogroups: function follows form

MAX MALLEN-COOPER

School of Biological, Earth and Environmental Science, University of New South Wales.
Email: m.mallen-cooper@unsw.edu.au

Biological soil crusts (biocrusts) are assemblages of mosses, liverworts, algae, lichens, fungi, bacteria and archaea that occur on the soil surface. While abundant in many ecosystems, biocrusts are particularly dominant in drylands, as their constituent organisms are highly tolerant of temperature and moisture extremes. Their effects on ecosystem functioning are extensive; they moderate erosion, contribute to nutrient cycles (notably cyanobacteria and cyanolichens are able to fix nitrogen), influence hydrology, and interact with other taxa as facilitators, competitors, habitat and food.

Many of these functional effects are associated with ecosystem goods and services. For example, the orchards of the Negev Desert capture substantially more runoff when the surrounding biocrust is undisturbed. Intact biocrusts also provide resistance to erosion, which costs billions of dollars per year in productivity losses and infrastructure damage at the global scale. Disturbances such as trampling by livestock and land clearing threaten biocrusts and therefore endanger the provision of these goods and services. A recent study has indicated that biocrusts are also susceptible to the effects of climate change, with temperature and watering treatments altering community structure to a considerable extent (Ferrenberg *et al.* 2015). Rehabilitation of biocrust communities has been investigated in several studies but has yet to be implemented in practice.

***Pleuridium nervosum*, a short moss. Photo: Max Mallen-Cooper.**

Morphogroups

Biocrusts can be very species rich, but identification of components to species requires considerable technical expertise. However, to investigate their functioning, biocrusts need not require identification to species, but can rather be identified to morphological groups (morphogroups). Following a seminal paper by Eldridge & Rosentreter (1999), lichen, moss and liverwort species can be classified into morphogroups on the basis of morphological traits such as height and shape. Some examples include: crust-forming (crustose) lichens, which grow as flat clusters of organisms; leafy (foliose) lichens, which have a flattened, branched structure extending above the soil surface; and shrubby (fruticose) lichens, which are branched and strongly three-dimensional. In addition to the Eldridge & Rosentreter (1999) groupings, mosses can be further divided into short and tall morphogroups as per Read *et al.* (2014), who use 15 mm as the threshold height value. Sometimes visible thread-like cyanobacteria (e.g. *Microcoleus* spp.) are also regarded as a morphogroup.

Species within the same morphogroup tend to respond similarly to disturbances and affect ecosystem functioning in a similar way. This is because morphology largely determines the type of mechanical stress to which an organism is subjected, the type of habitat provided for small invertebrates, the capacity of an organism to capture windborne nutrients, and various other attributes. Leafy lichens, for example, provide more opportunities than crust-forming lichens for web-building spiders to construct webs, and as Read *et al.* (2014) note, taller morphogroups are exposed to more shear forces from livestock trampling than shorter morphogroups.

The usefulness of the morphogroup system in assessing ecosystem functioning has so far been tested in the context of arthropod habitat, soil condition and disturbance by livestock (Eldridge and Koen 1998, Lalley *et al.* 2006, Read *et al.* 2014). The arthropod study assessed factors which influence arthropod assemblages, including the cover of three lichen morphogroups (Lalley *et al.* 2006). Although the relationships between the cover of the each morphogroup and the abundance of various arthropod groups were similar, crust-forming species of lichen were by far the most important in explaining the variation in arthropod assemblages. In the soil condition study, Eldridge and Koen (1998) found that morphogroup

assemblages differed markedly across sites of varying soil condition. Yellow leafy lichens were strongly associated with stable landscapes in good condition, whereas speckled crust-forming lichens and short mosses were indicative of less stable sites.

Even more encouragingly, Read *et al.* (2014) found that morphogroup composition had stronger relationships with explanatory variables than did species composition. For example, the cyanolichen morphogroup (lichens in which the photosynthesising symbiont is a cyanobacterium) was associated with long ungrazed sites, while leafy lichens indicated lightly grazed sites. The most compelling aspect of this finding is that despite morphogroup data being coarser and containing less information, morphogroups responded more strongly to disturbance than did individual species. In practice, morphogroups are considerably easier to classify than species, allowing more replicates to be performed per unit time. The ease of classifying morphogroups is also an economical advantage, as observers require less training.

Cladonia **sp. with characteristic erect squamules. Photo: Max Mallen-Cooper.**

Cladonia **sp. with fruiting bodies (podetia). Photo: Max Mallen-Cooper.**

Xanthoparmelia **sp., a member of the foliose lichen morphogroup. Photo: Max Mallen-Cooper.**

However, some biocrust species are difficult to classify into morphogroups. The lichen genus *Cladonia* is one example of a borderline case. Since these lichens grow as discrete flakes (squamules), they are usually classified as squamulose lichens. But *Cladonia* squamules protrude vertically from the soil in such a way that they resemble leafy lichens. Furthermore, when *Cladonia* species produce fruiting bodies (podetia), they can adopt the appearance of a shrubby lichen. When morphogroup classifications become unclear and subjective, as is the case with organisms whose morphology changes throughout their lifetimes or in different environmental conditions, there is potential for observer bias.

In conclusion, classifying to the morphogroup level saves time and requires minimal expertise. However, as with species, there are classification grey areas. Overall, the form or external appearance (morphology) of biological soil crusts is strongly indicative of their function. This is a valuable finding because it means that just knowing what an organism looks like can tell us something about how it might perform in the ecosystem. Certainly, function follows form.

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Extensive and diverse biocrusts protect remnant dunes and flood plains of Bladensburg National Park

WENDY WILLIAMS[1], BURKHARD BÜDEL[2], COLIN DRISCOLL[3]

[1] SAFS, The University of Queensland, Gatton Campus. Email contact: wendy.williams@uq.edu.au
[2] Department of Biology, University of Kaiserslautern, Germany. [3] SELS, University of Newcastle.

Bladensburg National Park (22.5033° S, 142.9881° E) is located 17 km south of Winton (NW QLD) and covers approximately 84,900 Ha. The northern section of the park is dominated by Mitchell Grass plains on cracking clays, with scattered small areas of Gidgee woodlands. In the north-western region there are extensive shallow-soil flood plains with low sandy hummocks dominated by Spinifex tussock grasses or *Eremophila* shrubs. A diverse and unique biocrust system was found covering a broad region including the flood plain (approximately 1000 ha).

Biocrusts from summer rainfall regions across Australia rarely contain lichens growing on soil as they cannot survive for long periods in hot, wet conditions (Rogers, 2006). In a study that covered a sub-tropical 1500 km east-west transect (latitudes 25–29° S), Rogers showed there was a significant relationship between rainfall, lichen diversity and growth form. However; well-developed biocrusts such as had been recorded in southern Australia were not found. Büdel and co-workers showed that, in Southern Africa, biocrust type and composition was determined by rainfall frequency and duration, and disturbance history (Büdel *et al.* 2009).

In areas near Skull Hole where fewer disturbances were apparent (Photos 1–4) there was an extensive biocrust system with a diverse range of lichens (9), cyanobacteria (5), liverworts (5) and mosses (2) (Table 1). From the road it would appear that this area is just a sandy plain with little to no vegetation. However, on close inspection the surface is almost entirely covered by a thick biocrust (depth 1–2 cm). Some areas had eroded but had been recolonised and stabilised with biocrusts (Photo 2). These are the first records of late successional crusts incorporating well-established communities of lichens and liverworts from a summer-dominated rainfall region in north-west Queensland (latitude 22° S). Rogers (2006) suggested that prior to disturbance there may have been extensive cyanobacterial crusts with some lichens such as those recorded in the Mulga Lands (Williams and Büdel 2012). At Bladensburg National Park we found both extensive cyanobacterial crusts and lichen-liverwort dominated crusts with the latter being unique to northern and western Queensland regions surveyed in 2006 (Williams and Büdel, unpublished data).

The sandy hummocks were colonised primarily by the cyanobacterium *Scytonema* sp. The bare interspaces of the tussock grasslands of either Mitchell grass or Spinifex (Engine Hole and Bough Shed region) or low shrublands were covered by well-established cyanobacterial crusts. Cyanobacteria *Scytonema* sp. and *Porphyrosiphon* sp. were most abundant, while *Nostoc* spp., *Pseudanabaena* sp. and *Phormidium* sp. were only found there (Photos 5–6).

This biocrust performs a range of ecosystem services by stabilising the fragile sands, providing organic material where nutrients are scarce and, as an important carbon sink. Carbon sequestration by biocrusts is estimated to account for at least 7% of terrestrial carbon annually (Elbert *et al.* 2012). Over time, and over large areas, high densities of microorganisms such as cyanobacteria that individually would have small impacts can confer strong ecological benefits on the plant-availability of macro- and micro-nutrients. Terrestrial cyanobacteria primarily inhabit biocrusts that drive physical and biological processes in the topsoil. These microbes enable resilience to drought and maintain soil fertility. These unique biocrust ecosystems need to be prioritised for conservation for their central role in arid landscape function.

Table 1. Biocrust diversity found at Skull Hole, Engine Room and Bough Shed sites at Bladensburg National Park

Lichens	Cyanobacteria	Liverworts
Lecidea sp.	*Scytonema* sp.	*Riccia lamelosa*
Endocarpon spp.	*Schizothrix* sp.	*Riccia crinita*
Peltula patellata	*Gloeocapsopsis* sp.	*Riccia limbata*
Psora sp.	*Porphyrosiphon* sp.	*Riccia longiciliata*
Psora crystallifera	*Stigonema* sp.	*Riccia nigrella*
Diploschistes thunbergianus	*Nostoc* spp.	**Mosses**
Toninia sp.	*Pseudanabaena* sp.	*Goniomitrium enerve*
Heppia despreauxii	*Phormidium* sp.	*Eccremidium arcuatum*

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Considerations for large-scale biodiversity reforestation plantings. Part 6: landholder and community engagement

DAN COLE[1] AND GREG SIEPEN[2]

[1] The Water and Carbon Group, Brisbane, Qld. Email: d.cole@waterandcarbon.com.au
[2] Ecological Consultant. Email: gregory.siepen1@gmail.com

Introduction

This article is the sixth in a series discussing considerations needed in large-scale tree planting for biodiversity outcomes. We focus on the key areas of communication that have proven effective to inform the community, landholders and other stakeholders assisting to build partnerships and support for such projects. We suggest improvements for the future design and management of projects that involve people using these reforested sites and that integrate community involvement over time.

Communication strategy

It is vitally important to have an effective and simple communication strategy for each project. Communication about various aspects of the project will need to occur both within the organisation and with other organisations (e.g. state, local and federal departments), adjoining landholders and the wider community to ensure the project is undertaken within time lines and within budget. Therefore, significant players will need to be identified very early so that they are kept informed of progress and have an opportunity to give feedback or voice concerns.

Although most large-scale plantings or forest restorations need to be undertaken on an industrial scale, it is important to have a landholder and community engagement strategy to ensure local and community-wide concerns are taken into account and that correct information is being transferred.

Landholders

Landholders adjoining proposed planting sites should be consulted and the plans discussed openly with a view to modification, if required, for such aspects as fire risk. Consulting should start very early in the process to ensure that any issues can be discussed and hopefully resolved within the project time lines. There may be specific requests from landholders that can be incorporated with minimal project impact such as enhanced set-backs, fire breaks and site stratification (e.g. understorey corridors that omit canopy trees to minimise branch drop or to ensure views are retained).

Personal representation is often a very useful method to gain the landholders' trust and for them to see the draft plans first-hand. Several meetings may be required before the plans are agreed to. But once agreed, they should be implemented without any negative input from the landholders provided they are regularly kept informed of progress and completion dates.

Adaptive management even in the planning phase can mitigate costs and potential hostility for all involved before any implementation works are undertaken. Land being excluded from the project post-planning can be a consequence of poor engagement and will have impacts on the proponent and contractors in regards to relationships and budgets.

Community engagement

There are a number of strategies that can be applied to gain the support of the wider community and keep them informed such as:

- Websites (where access is available).
- Community planting days.
- Newsletters or e-newsletters.
- Joint activities with community organisations (e.g. Rotary).

Author Greg Siepen demonstrating tree planting to a school child. Photo: Dan Cole

Website

Designing a website that is attractive, interactive and simple can assist greatly in information transfer and communication. The website can provide a range of functions such as highlighting community planting days and providing a means of registering for them (for insurance purposes); an avenue for public feedback; show highlights of the bigger planting program; and address issues of concern.

Community planting days

Reforestation in public areas can benefit through community planting days. If planned well and the public relations programs reach far and wide, a large number of people will attend these activities. For example, one could hold a community planting activity in a public park in association with local government regular 'Environmental Days'. The attending public may enjoy the range of activities available provided by Council as well as learn something about a large-scale tree planting project and how to plant seedlings successfully. All these activities build bridges between the organisations involved, the community and other stakeholders.

Newsletters

Newsletters, whether hardcopy or via email, are very useful to provide information to keep the public abreast of what is going on with a large-scale tree planting project. They can provide a number of functions including providing for surveys of the general public, distributing information and achievements of the project, and providing avenues for feedback.

Joint Activities

Holding joint activities with well-recognised organisations such as Rotary will assist in building bridges with various groups in the wider community. It also allows the community to be put in touch with successful organisations which can benefit the community via support for individuals and projects.

Future engagement and planning considerations

Integrating social and cultural values into large-scale reforestation

Beyond the ecological benefits that reforestation can provide such as habitat, erosion protection, improved soil fertility, carbon sequestration, corridors and connectivity, large-scale tree projects can offer further social and cultural benefits. For instance, in highly urbanised areas communities are now seeking increased opportunities for public spaces that afford a sense of nature along with amenity and recreational values. Well-designed biodiverse forests can provide these values and meaning to the community without the long-term maintenance requirements of traditional parks.

Landholders inspecting Brush Box, *Lophostemon confertus,* as part of a veteran tree workshop. Photo: Dan Cole

Instead of implementing standard reforestation methodologies primarily focused on site capture and habitat objectives, the planning and management can also include the social-ecological exchange so that biodiverse forests are established to be permeable places and a recreation destination.

An example from south-east Queensland is a biodiverse forest integrating an environmental arboretum at the Griffith University, Logan Campus undertaken in 2014. This particular project was developed as a partnership between Logan City Council, Griffith University and The Water and Carbon Group as part of the Slacks Creek Restoration Project which is funded by the Federal Government.

The arboretum focus is a regional and cultural collection of key tree species that have Indigenous and European significance underpinned by the Queensland Government Regional Ecosystem Framework. For instance, tree species that were logged for settlement, including rainforest cabinet timber trees, have been included. The arboretum also includes rare and threatened species endemic to south-east Queensland giving it a valuable role in *ex-situ* conservation as part of the living collection. The project has already remediated the degraded site and activated the open space, while providing an asset for the university and the community that will have ecological, educational, research, amenity and passive recreational benefits. The project has only been realised through strong partnerships and effective communication particularly in the planning phase.

As part of the planning framework in future projects landholders, communities and traditional owners should be consulted to understand broader views and potential visions for particular sites. This would often provide more information on local history and identify any concerns that need to be addressed. This could become an effective layer in the planning phase to drive

reforestation design that embraces community-based aspirations while still being underpinned by restoration ecology. Typically, current project planning budgets do not allow for extensive community-wide or regional community consultation.

Community enhancement planting and maintenance – the understorey

A mixed species native canopy implemented in the commercial project delivery can provide the framework for enhancement planting of the understorey by the community to increase species diversity. Once the canopy is established weed pressure declines as shade increases in association with previous weed management activities. It's at this stage that an established large-scale planting can provide understorey enhancement opportunities for community and landcare groups as the commercial risks for the proponent are reduced and likewise for the community groups.

Enhancement planting and maintenance can build on community planting days by providing these groups with natural areas to work in over a long period. Successful community engagement can facilitate 'local ownership' and ensure the longevity and enrichment of the project.

Concluding summary

Identifying and engaging with relevant stakeholders that may be involved or impacted by the reforestation early in the project development is important.

Projects must consider people using these reforested sites and aim to integrate community involvement over time. Griffith University, Environmental Arboretum, Logan campus, QLD. Photo: Dan Cole

Personal representation and other communication mediums can assist in reducing uncertainty, increasing understanding of project objectives and building trust amongst the landholders and community. Greater engagement in the planning of large-scale reforestation projects can assist with integrating social and cultural values to help communities develop a deeper connection to the site. In the next article we examine risk management and contingency planning.

Considerations for large-scale biodiversity reforestation plantings. Part 7: risk management and contingency planning

DAN COLE[1] AND GREG SIEPEN[2]

[1] The Water and Carbon Group, Brisbane, Qld. Email: d.cole@waterandcarbon.com.au
[2] Ecological Consultant. Email: gregory.siepen1@gmail.com

Introduction

This article is the seventh in a series discussing considerations needed in large-scale tree planting for biodiversity outcomes. Risk assessment, management and contingency planning are requirements for every project. Identifying the risks and contingencies in the project planning phase and incorporating measures to address these are essential to a successful outcome of the project. In this issue we analyse a number of risks and contingencies and discuss ways of overcoming them.

Managing contract risks

Risk management can really start at the contract stage. There needs to be a clear understanding of the deliverables in the technical specification. Large-scale reforestation requires an industrial-scale approach. Consequently, a very prescriptive contract can avoid misunderstandings in carrying out the project. The more thoroughly the restoration process is detailed in a contract the less potential there is for mis-interpretations of clauses to disrupt the completion of the project.

Similarly there must be a clear delineation of responsibilities and financial obligations between the client and contractor around mortality or other damage as a result of natural disturbance including fire, flood, drought (extended dry periods), pest or acts of vandalism. These disturbances may be beyond any party's control although rectification works will most likely need to occur. Typically these costs are funded by the client at their discretion.

Financial management – contingency

The client should allow for stochastic events and rectification works as part of the entire project budget. A lack of funds to cover these may lead to project failure. The client should select a contractor with proven ecological restoration experience with capacity to deliver projects at scale. The project management of the principal contractor needs to allow a contingency in their budgets for unforeseen activities. This could include additional time for staff to meet with landholders in the planning phase or to manage a new weed incursion during the maintenance period.

Contract growing – plant procurement

Perhaps the most underestimated risk to implementing a large-scale reforestation program is plant supply. Long lead-times are often required for seed collection, native tube production and to achieve the species diversity required, especially if licences are required for collecting propagules for threatened species and genetic provenance is an issue. Even implementing a Phase 1 treatment of pioneer and primary canopy trees as a framework could include 20 to 30 species.

Contract growing must be coordinated in the planning phase. The timing of this is critical as delays could incur significant costs. For instance, further site preparation may need to be undertaken to manage weeds if the stock is not ready. Delays may lead to nursery holding-charges in addition to the contract price while long delays may ultimately lead to pot-bound stock. Plant procurement requires pro-active management to mitigate losses and costs. This can include monitoring native tube progress in the nurseries and planting out selective zones of the project when species become available.

Flexibility and good relations between the client, contractor and nurseries can help in overcoming these risks which can severely damage the economic viability of a company. There may often be a need to adapt the planting program to fulfill contract growing obligations and to ease the pressure on contractors which will ensure planting quality is not compromised.

Quality assurance – contractor management

Quality assurance is a key factor to ensure that each site and the overall project meet agreed goals and outcomes. Contractors must be committed, flexible and well-resourced to undertake large-scale biodiverse reforestation projects. The consequences of poor contractor and sub-contractor performance can include increased costs, damage to the relationship with the client and even project failure.

Stochastic events: floods, herbivores and vandalism

One factor that is essential to any large-scale planting is provision for unforeseen stochastic events such as floods, rapid increases in herbivores and vandalism during the planting and initial maintenance phases.

Floods

As part of the Brisbane City Council (BCC) 2 Million Trees (2MT) project over 400,000 tree and shrubs were planted out in corridor plantings at the Wacol Government Precinct. This planting project is surrounded by Wolston Creek and Brisbane River and it was significantly affected during the 2011 and 2013 flood events that impacted south-east Queensland.

The two floods had different effects on the Wacol precinct. The major effects of the 2011 flood were the deposition of thick layers of silt in drainage lines and the inaccessibility for site maintenance (mainly for weed control) due to soil water logging. Mortality was related to heavy silt deposition creating anaerobic conditions in the root zones of establishing trees. The 2013 flood event did not inundate so wide an area although the water remained longer than in 2011. In turn tree mortality was attributed to prolonged inundation and not silt deposition.

The floods were not predicted in the planning phase of the 2MT project and the 2011 event was the first such extreme extent since 1974. The client, BCC, provided extra funds for replanting, additional maintenance and to reinstate access to ensure the whole project would be completed by the required timeframe.

An area of silt deposition from the 2011 flood event at the 2MT Wacol project. Photo: Dan Cole

Kangaroos traversing through planting projects can damage tree stock. Photo: Dan Cole

Herbivores

In the 2MT project herbivore damage occurred at several sites but was greatest at the Wacol Precinct which forms part of the larger habitat area for a population of macropods, mainly eastern grey kangaroos that have become landlocked through urban and industrial development. It appeared that kangaroo numbers increased dramatically in the three year period of planting and maintenance due to rainfall and landscape conditions favourable to breeding.

The increase in population became a degrading pressure and a risk to the success of the Wacol projects. The kangaroo damage included browsing, trampled trees, broken limbs and stems. This also lead to secondary issues such as poor tree form, restricted growth and an increased incidence of pest and disease. Negotiation between the client, BCC, and the principal contractor lead to funds being made available to increase the maintenance regimes and provide plant protection (corflute tree guards) to reduce damage.

Other animals that can affect growth and development of trees are rabbits, hares, stock and deer. Rabbits are mainly grazers, eating grass. In many areas of Australia, they are not causing economic damage to large-scale tree planting ventures. Hares can kill or damage seedlings and cannot always be fully controlled and protecting each plant is usually the outcome, using a form of tree protection. Stock need to be excluded from plantings until the trees are large enough to handle rough treatment and minor browsing. The most effective method is to erect stock-proof fencing around the planted sites. Finally, deer may eat very young trees even when they are protected by tree guards. Additionally, stags (males) will rub their antlers against the trees, breaking branches and stems and killing or severely damaging the tree growth.

Vandalism

In most areas vandalism does not cause economic damage to large-scale tree plantings. However, in urban or peri-urban areas vandalism is more evident and this risk needs to be considered. In the early stages when people and machinery are regularly on the site vandalism is rare or absent. In the later stages of maintenance (i.e. three years after planting) trees will often be large and tall enough and not present a 'challenge' to would-be vandals. Arson can be a problem and a fire management plan should be put in place.

Monitoring, mortality and replanting

Consistent monitoring as the forest emerges through the maintenance period can provide a deeper understanding of the restoration trajectory. This can inform the need for any strategic maintenance that may assist the site to progress towards the intended destination of the target reference system.

It is important to progressively replant throughout the maintenance period where practicable. This will ensure that the canopy structure is established across the site. Another important consideration in regards to mortality is that it is often a measurable performance indicator within the contract and sometimes can form the final maintenance obligation for a contractor to achieve 'off maintenance'. Pro-active replanting allows the contractor to manage costs throughout the maintenance period as opposed to undertaking a major replanting event at the end which can be expensive.

Concluding summary

Identifying the potential risks including stochastic events that may impact a project is important for both the client and contractor. Similarly both the client and contractor must have clear agreements for managing problems and sufficient contingency funds to rectify damage from unexpected events. A pro-active approach to managing plant procurement is essential along with monitoring sites to progressively replant is highly recommended. In the next issue we examine project monitoring and evaluation.

Author Greg Siepen inspecting deer damage on a 2MT project. Photo: Dan Cole

News from the Australian Seed Bank Partnership

Collaboration across the Nullarbor: WA banksias find a new home in the ACT

ANNE COCHRANE

Threatened Flora Seed Centre, Department of Parks and Wildlife, Western Australia.
Email: anne.cochrane@dpaw.wa.gov.au

Seed exchange is not the usual practice for the Western Australian Department of Parks and Wildlife's Threatened Flora Seed Centre (TFSC). This facility is a conservation seedbank with a focus on the collection and conservation of seed of conservation-significant species endemic to the State, and their use in threatened plant reintroductions and in research.

However, in 2014 the Australian National Botanic Gardens (ANBG) Curator of Living Collections, David Taylor, was interested in obtaining seeds of *Banksia* species for display in Canberra. Whilst predominantly for display, the plants would also form a second, living, *ex situ* conservation collection to support seed conservation efforts. The WA seedbank offered to supply the ANBG with small quantities of seeds from their collections for this purpose. Most of the species were commonly occurring endemics originally collected for a project that assessed the temperature thresholds for germination in the genus, research which has recently been published (Cochrane A. 2015. Can sensitivity to temperature during germination help predict global warming vulnerability? *Seed Science Research*).

A consignment of seeds from 28 collections was sent across to Canberra late in 2014 and included a handful of conservation-listed species. The TFSC requested that germination of the seeds be done under similar conditions to that conducted in their laboratories so that data would be compatible. Germination data obtained at intervals during long term seed storage helps to identify issues with storage conditions: if viability declines then storage conditions can be changed or seed recollected. Seed germination was conducted at the National Seed Bank at the ANBG. This seedbank focuses on the conservation, research, propagation and supply of native Australian seed, predominantly from threatened Australian alpine, subalpine and Southern NSW tableland grassland plant communities.

ANBG staff with Banksia seedlings. Photo: Lydia Guja

Banksia seedlings at the ANBG. Photo: Lydia Guja

It was very pleasing to see that the majority of the collections attained >75% germination, indicating that to date seed viability has been maintained during storage at -20 °C. The resultant seedlings are being grown on, and will be tested for their ability to cope with the harsher ACT winter and displayed in a range of locations around the ANBG in large containers featuring specialised growing media. Others are destined to feature in a future *Banksia* garden which is currently in the planning stage.

Both the National Seed Bank and the Threatened Flora Seed Centre are members of the Australian Seed Bank Partnership, an Australia wide initiative aimed at a national effort to conserve Australia's native plant diversity through collaborative and sustainable seed collecting, banking, research and knowledge sharing for better outcomes in plant conservation and restoration. This conservation and cultivation of an iconic memorable Australian genus is a truly collaborative project for the ASBP.

ANPC Member Profile

Michelle Haby

Michelle Haby

What is your current position?

Five years ago I started an environmental consulting business with my partner, called Botanical Enigmerase. Since then, I have become accredited by the South Australian Native Vegetation Council to conduct vegetation surveys for clearance applications. I am the only accredited consultant on Kangaroo Island (KI), as my mentor and predecessor, Bev Overton, is in the process of retiring. When she decides to finally 'hang up her boots', she is going to give her impressive herbarium collection to me, which is an amazing and humbling honour.

What are you working on at the moment?

Kangaroo Island's economy is predominately driven by agriculture and tourism. As such, there isn't a lot of environmental consulting work available. It is mostly assessments for clearance applications for roadside verge works or tourist developments. A neat project that I have just become involved in though, is the development of an assessment process for determining if revegetation is eligible to be protected under the *Native Vegetation Act 1991*. This work is being done with Natural Resources KI. It is hoped that a simple, streamlined process can be developed that will encourage farmers and lifestyle property owners who have carried out some revegetation on their properties to get these areas protected in an official capacity.

The locally endemic *Beyeria subtecta* (Kangaroo Island Turpentine Bush), a nationally threatened plant species. Photo: Michelle Haby

How did you end up working in plant conservation?

When I was in my mid-teens I did some volunteer work with Kangaroo Island botanist, Bev Overton. I mainly assisted her with some fire research that she was doing at the time. Amongst other things, this involved identifying and counting seedlings within 1x1m quadrats. I discovered that I was reasonably good at remembering what the different seedlings looked like and correctly identifying them, which gave me a huge buzz. Working with Bev lit a spark that smoldered away for quite some time.

Then in 2008, I was lucky enough to be given the opportunity to do some part time work in the Kangaroo Island Nationally Threatened Plant Projects (KINTPP) nursery. Initially, I was just doing a bit of transplanting of seedlings. Then one day my boss showed me the seed storage area and said "Do you want to have a go at germinating some of the tricky seeds in here?" I thought that all of my Christmases had come at once! For a long time, I had had an interest in germinating natives, but once I was let loose on the KINTPP seedbank I was seriously bitten by the germinating bug. Over the next five years I was able to drastically increase the diversity in the revegetation areas and include a number of nationally threatened, state listed and regionally significant plant species in the mix. I had a small germinating victory last year when I achieved 65% germination from the locally endemic *Beyeria subtecta (*Kangaroo Island Turpentine Bush), one of KI's nationally threatened plant species that I had been tinkering with without much success for the past four years.

How long have you been involved with the ANPC?

A copy of *Australasian Plant Conservation* (APC) came across my desk in 2012. It was a lead up issue to the 9th National Conference in Canberra. The conference sounded really good, so I decided to go. I signed up as a member before the conference and then presented a poster at the conference. I came away from the conference with my head spinning with inspiration. In 2014 Doug Bickerton nominated me for a position on the committee as an ordinary member. Since joining the committee I have also helped out with proof reading sections of the APC Bulletin.

Are you involved in any volunteer activities?

I am involved with the Friends of Cape Gantheaume (FoCG), which is a Friends of Parks group. It is quite a small group, but we have achieved some great things mainly in the Cape Gantheaume Conservation Park. Some of our activities have included building viewing platforms, maintaining historical building sites and threshing floors as well as the usual revegetation works. I have been involved with FoCG for 15 years now.

My other volunteer activity is as Treasurer for the local Gymnastics club which my girls attend. I have been on the Gymnastics committee for about 10 years.

Is there anything else you would like to mention?

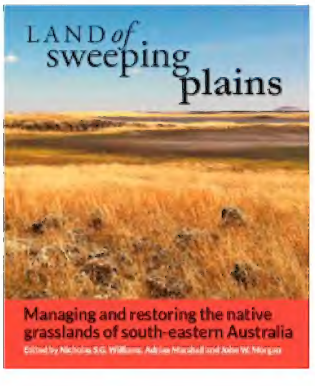
I am passionate about conserving native vegetation. I firmly believe that revegetation plays a big role in conservation. I would like to see a lot more nursery based trials into germination done. This way, local nurseries can restore habitat in a cost effective manner with the full spectrum of species that once grew there. I also think that the general community's gardens can play a role in threatened and regionally significant plant species conservation. By making these species available to the public, they can gain an appreciation and connection with them, thereby increasing their profile and worth.

Book reviews

Land of Sweeping Plains. Managing and restoring the native grasslands of south-eastern Australia

Edited by Nicholas S.G. Williams, Adrian Marshall and John W. Morgan

CSIRO Publishing, Melbourne 2015
449 pp ISBN: 9781486300815 RRP AU$59.95



For those who love, are interested in, work in, or want to understand more about our native grasslands, *Land of Sweeping Plains* is a great addition to your library or reference collection. As referenced in the book, Australia's native grasslands are amongst its most threatened plant communities and are still under constant pressure from active clearance, conversion, weed invasion and plain ignorance and neglect.

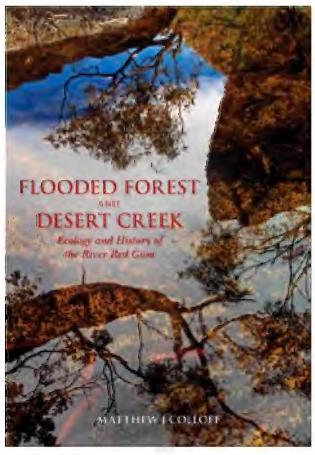
This publication aims to address the understanding and ignorance with a broad coverage and wealth of knowledge and data. Because of their inherent importance to both ecology and agricultural production, understanding and management of grasslands has become increasingly important to scientists, naturalists and producers alike.

The paperback publication of 449 pages brings together scientific research, policy, the experience of land managers and restoration ecologists, and community interests into a resource for anyone interested in grasslands. Chapters cover topics from areas as diverse as social history, ecology, wildlife habitat management, biomass and fire management, restoration ecology, seed production, weeds, and perspectives on the future of grasslands and impacts of climate change.

Land of Sweeping Plains is extensively and beautifully illustrated with photos, figures and tables to make it a pleasure and a wealth of information to read.

Martin Driver. ANPC, Canberra

Flooded Forest and Desert Creek
Ecology and History of the River Red Gum



by Matthew J. Colloff

CSIRO Publishing, Melbourne 2014
325 pp ISBN 9780643104209 hardback, $69.95

The river red gum, *Eucalyptus camaldulensis*, has the widest natural distribution of any eucalypt and is one of the most recognisable of gums. It is an iconic species, and features frequently in landscape paintings of inland Australia. It is also of great economic value. Its timber was important, particularly for railway sleepers, a use for which has now been replaced by concrete, however red gum sleepers are still widely used as retaining walls in gardens. Grazing of the grassy understorey of river red gum forests was also important, and the use of the red gum forests for grazing remains an active controversy.

If any eucalypt deserves a monograph devoted to it, it is surely *E. camaldulensis*, and Matthew Colloff is to be congratulated on this rich account of its biology, history and cultural, both indigenous and European, significance. The story of the river red gum is important in itself, but the author argues persuasively that it also illustrates a wider story of our changing appreciation and understanding of the Australian environment.

The name *Eucalyptus camaldulensis* was coined by a German botanist Friedrich Dehnhardt in 1832, for a tree growing in the garden of the Count of Camaldoli, near Naples in Italy, although its original provenance is not known. At the time, the tree was over 12 metres tall, and must have been at least 10 years old. However, recent examination of Dehnhardt's type specimen reveals a problem – it is not the same as what has been regarded as *E. camaldulensis* by Australian botanists for many years. Indeed it is not possible to identify Dehnhardt's specimen to any known species. To prevent confusion, and to preserve a name used and understood for decades, it was necessary to select a new type specimen. The new type, selected by Brooker and Orchard, is from Currency Creek in South Australia. We can continue to use the name *E. camaldulensis,* confident that the plants to which it is applied represent the same species as that discussed by generations of Australian botanists and foresters.

The breadth of scholarship displayed in the book is remarkable, spanning a range of both sciences and humanities. It is a well-designed and superbly illustrated production, which deserves to become one of the classics of Australian natural history writing.

Paul Adam. School of BEES University of NSW

News

National Seed Science Forum 14–16 March 2016

www.seedpartnership.org.au/seedscienceforum

The ANPC is proud to be collaborating with the Australian Seed Bank Partnership which is coordinating the National Seed Science Forum in March 2016. The Forum will be held at the Australian PlantBank and hosted by the Australian Botanic Garden, Mount Annan, and also in collaboration with the Australian Grains Genebank. Registrations close on 29 February 2016.

The draft programme is now available. Local and international experts will be speaking on seed conservation, storage, preservation and germination. Keynote speakers for the Forum will be Dr Christina Walters, Professor Kingsley Dixon and Professor Angela Moles. Entries to the World of Seeds Photography Competition also close on 29 February. Five prizes to be won. Forum participants are invited to submit up to 3 digital photographs which will be digitally displayed at the Forum and delegates will be voting for their favourite in each category: Landscapes; Microscopy; Up close and personal macro; Seeds and the environment; and Digitally manipulated/multimedia enhanced photos. There is no entry fee for this competition.

National Standards for Ecological Restoration in Australia

http://seraustralasia.com/pages/standards.html

The Society for Ecological Restoration Australasia (SERA) has designed these Standards to encourage all restoration and rehabilitation projects in Australia to reach their highest potential. SERA and 12 partner organisations, including the ANPC, collaborated and developed the Standards over the last three years - carefully considering the needs of all stakeholders, including input from well over 100 practitioner, research, conservation and agency representatives from around Australia. Public comment closed on 15 February 2016. The Standards will be accompanied by an online interpretation that will be illustrated by examples. Both are scheduled to be launched on March 15th 2016 at the National Seed Science Forum, Mt Annan Botanic Gardens, Sydney, after which they will be available online.

Workshop report

Grassy Woodland Ecology and Management

MARTIN DRIVER[1] AND CATHY OLIVE[2]

[1] Australian Network for Plant Conservation. Email: projects@anpc.asn.au
[2] Euroa Arboretum. Email: euroaarboretum.com.au

A recent (October 20–24 2015) week-long series of informative, real-world workshops was hosted by the Euroa Arboretum in north east Victoria and supported by the Victorian Government, Communities for Nature, and Goulburn Broken Catchment Management Authority (GBCMA), on the theme of Grassy Woodland Ecology and Management.

Historic records by early settlers regularly referred to viewing grassy woodlands as 'a Gentleman's Park' with scattered trees and rich with lilies and herbs. These were cultural landscapes – modified carefully by Indigenous people through fire and the harvesting of animals and plants. Since early colonisation, they have been the first areas to be settled – attractive to early settlers by their open grassy plains and scattered trees. In recognising the importance in managing these landscapes – either for conservation or the retention of native grasses in a grazing system, the Arboretum established a course in 2014 to assist land managers in the active management of this landscape – feeling this could be of greater value than the traditional method of planting more trees and shrubs ubiquitously across the landscape.

Attended by over 140 participants over the five days, the workshops covered the issues of assessment of grassland site conditions, setting site management objectives, adaptive management actions and techniques and the role and benefits of native grasslands in a productive agricultural landscape.

Special attention was given to the practicalities of restoration, weed/ biomass management and demonstrations of use of fire and habitat management. There were field inspections of properties actively managing their Grassy Woodland for conservation and tackling issues like kangaroo over-grazing, Grey Box regeneration, managing for a threatened species and some fantastic remote camera footage of bird activity. A visit to a productive grazing farm in Bonnie Doon highlighted the importance of the native grasses on the steep hills for soil protection, but also the value they hold as low input grasses within a rotational grazing system. Site tours of the Euroa Arboretum restoration areas and Seed Production Areas, with demonstrations of native seed harvesting and processing and Bush Tucker supply and uses, was also a highlight.

Paul Gibson-Roy responding to workshop participants from his own experience on grassland restoration management at the Euroa workshops. Photo: Martin Driver

Some of the raised bed forb Seed Production Areas (SPAs) at the Euroa Arboretum. Photo: Martin Driver

Speakers over the week included Dr Paul Gibson-Roy, Paul Foreman, Dr Mike Clarke, Dr Ian Lunt, Dr Ian Mansergh, Libby Woodward, Gary Hendy, Bertram Lobert, Dr Peter Mitchell, Dr Meredith Mitchell, Kerri Goschnick, John Evans, Shane Monk, Cathy Olive, Kim Wilson, Kate Stothers, Liz Evans, Kim Magnay, and Janet Hagen.

Dr Sharman Stone, Federal Member for Murray also attended and announced recent successful Federally funded Community Grants. She also highlighted the importance of the Euroa Arboretum and infrastructure of Seed Production Areas and seed supply systems that underpin all the government and community environmental works that are undertaken in the Goulburn Broken CMA.

Further contact: Cathy Olive, Euroa Arboretum, cathy.olive@euroaarboretum.com.au

Research Roundup

COMPILED BY KIRSTEN COWLEY

Centre for Plant Biodiversity Research, Canberra. Email: Kirsten.Cowley@csiro.au

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Contributions to Research Roundup are welcome, and should be sent to Kirsten Cowley at the above email address using an email subject heading "APC Research Roundup" or similar. Their inclusion will be subject to available space.

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Australian Seed Bank Partnership
National Seed Science Forum

Australian Botanic Garden, Mount Annan, NSW
14–16 March 2016

AUSTRALIAN SEEDBANK PARTNERSHIP

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NINTI ONE CRC REMOTE ECONOMIC PARTICIPATION

The National Seed Science Forum will bring together leading botanical and agricultural institutions, seed scientists, and conservation and restoration experts to share ideas that showcase the importance of seed science to the future of plant conservation and food security in Australia.

WHERE: Hosted by The Australian Botanic Garden Mount Annan, the Forum will be held at the Australian PlantBank, in collaboration with the Australian Grains Genebank and the Australian Network for Plant Conservation.

WHEN: The Forum will commence with an evening event on Monday 14 March, with the main science programme being presented on 15–16 March 2016.

WHO: An exciting programme of local and international experts is planned, speaking on seed conservation, storage, preservation and germination. Keynote speakers for the Forum are:

- **Dr Christina Walters:** Research Leader in Plant Germplasm Preservation Research at the National Center for Genetic Resources Preservation in the United States
- **Professor Kingsley Dixon:** Curtin Professor at Kings Park and Botanic Garden in Perth
- **Professor Angela Moles:** Professor at the School of Biological, Earth and Environmental Sciences at UNSW

An Expert Panel Discussion, supported by the *Cooperative Research Centre for Remote Economic Participation*, will explore the issues and sensitivities for researchers when working with biological material and Aboriginal and Torres Strait Islander people's knowledge about this material.

The Panel members will include:

- **Terri Janke** (Panel Chair), Solicitor Director, Terri Janke and Company
- **Leanne Liddle**, Senior Policy Advisor, Northern Land Council
- **Gerry Turpin**, Ethnobotanist and Adjunct Senior Research Fellow, Australian Tropical Herbarium

KEY DATES

Forum registration closes	29 February 2016
Forum	14–16 March 2016

For more information visit:
www.seedpartnership.org.au/seedscienceforum


RTBG


ANDREW CRAWFORD, DPAW


ANNE COCHRANE, DPAW


JOHN GOLLINGS

The Australian Seed Bank Partnership is a national effort to conserve Australia's native plant diversity through collaborative and sustainable seed collecting, banking, research and knowledge sharing. **Our vision** is a future where Australia's native plant diversity is valued, understood and conserved for the benefit of all.